G15 Age Estimation in Children and Subadults Combining Ratios of Pulp and Tooth Area With Tooth Development

Manasa Ravoori, BDS, KULeuven, Leuven B3000, BELGIUM; Jannick De Tobel, MD, Ghent University, Department of Radiology, Gent, Oost-Vlaanderen 9000, BELGIUM; Patrick W. Thevissen, PhD, KULeuven, Leuven, Vlaams-Brabant B-3000, BELGIUM*

Learning Overview: After attending this presentation, attendees will understand why adding pulp and tooth ratios to tooth development on panoramic radiographs is of limited value for age estimation in children and subadults.

Impact on the Forensic Science Community: This presentation will impact the forensic science community by showing why adding pulp and tooth ratios to tooth development on panoramic radiographs is of limited value for age estimation in children and subadults.

Introduction: Dental age estimation methods are mainly based on tooth development or on morphological changes observed in teeth.[1] In children and subadults, certain teeth are mature and start forming secondary dentin. Combining the age-related information of these secondary dentin formations and tooth development may improve the age prediction performances in children and subadults.

Goal: To detect if, in children and subadults, secondary dentin formation provides added age prediction information to tooth development.

Materials and Methods: Retrospectively panoramic radiographs of 453 subjects (228 females and 225 males) in the age range between 8 and 25 years were selected. The radiographs were imported in image-ameliorating software (Adobe® Photoshop®) to measure the pulp and tooth areas in the crown and the crown plus root portion of teeth 33 and 36 (Fédération Dentaire Internationale (FDI) nomenclature). For both teeth, the respective ratio between pulp and tooth area in the Crown (CR) and the Crown plus Root portion (CRR) were calculated. The development of the lower left seven permanent teeth and all present third molars were staged according to the Demirjian et al. and the Köhler et al. staging technique, respectively.[2,3] Within the group of children, it was verified for each of the ratios separately whether they contribute additional information to the age estimation based on the Willems et al. age estimation method.[4] To this purpose, a regression model for age was used with the prediction based on the Willems et al. method and the ratio as predictors. To evaluate the total dataset, the added value of the ratio information to the Kohler staging a similar approach was used. The age estimation based on the Kohler stages of the third molars was obtained applying Bayes rule with a multivariate continuation-ratio model as conditional distribution.[5] To quantify the age prediction performances of the models, the Mean Error (ME), Mean Absolute Error (MAE), and Root Mean Squared Error (RMSE) were calculated.

Results: Within the group of children, the CRR in tooth 36 significantly added information to the Willems et al. method, for males (p=0.0073) as well as for females (p=0.0002). However, the improvement in MAE was small and not significant (decrease in MAE=0.032 years (SD=0.303), p=0.09). The CR for tooth 36 added significant information to the Willems et al. method within females, but the change in MAE was not significant. Neither for the CRR, nor the CR measured in tooth 33, was there any evidence that they contributed information to the Willems et al. method.

Neither for the CRR, nor the CR measured in tooth 36, was there evidence that they added information to the Kohler et al. stages. Only for males was the addition of the CRR significant, but this was not reflected in a significant decrease of the MAE. The MAE was significantly higher (but small) when adding the ratio information for females. Neither for the CRR, nor the CR measured in tooth 33, was there any evidence that they added information to the Kohler et al. stages.

Conclusion: On panoramic radiographs in children and subadults, pulp and tooth ratios were used as a measure of secondary dentin formation, but they did not provide added age prediction information to tooth development.

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